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# THE PHILIPPINE COTTON BOLL WEEVIL

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WITH ONE PLATE

The subject of cotton pests has apparently received little attention in the Philippine Islands. In fact so little is known of the insects affecting the cotton plant here that its most serious pest, *Amorphoidea lata* Motsch., does not appear in economic entomological literature, with the possible exception of a short note by Hunter and Hinds (1), who apparently knew of the occurrence of a cotton boll weevil in the Philippines as witnessed by their statement that "In the Philippines there has been found a species of weevil which is distinct from the Mexican cotton boll weevil, but attacks cotton in a very similar manner." In the interest of the Philippine cotton industry and for the information of quarantine officials throughout the world, a study of the life history and habits of this pest was undertaken in June, 1921.

## DISTRIBUTION

*Amorphoidea lata* was originally described by Motschulsky (2) in 1858. He records it from "India Or." Gemminger and Harold (3) list it from the same locality although it is not mentioned in available Indian literature, and Ramakrishna Ayyar (4) in a recent paper of the "Weevil fauna of South India with special reference to species of economic importance" does not include it. Schultze (5) lists it from Manila, Luzon, on the basis of specimens determined by K. M. Heller. Specimens are in the Bureau of Science collection from Maao, Occidental Negros, and Manila, Luzon. In the collection of Dean C. F. Baker it is recorded from Sibuyan, Romblon; and Surigao, Mindanao. I have collected it from Los Baños, Laguna, and San José, Mindoro; and I have specimens from Taal, Batangas, and Ilocos Norte. There is little doubt but that it will be found spread throughout the Islands, not only from the evidence of widely scattered collection localities, but also from the fact that it breeds naturally in at least one native wild food plant in addition to the cultivated cottons.

## LIFE HISTORY

*Egg.*—The egg is smooth pearly white (Plate I, Fig. 2). Considerable variation in shape from elliptical to ovoid has been observed. Average size from a

[1] Experiment Station Contribution, No. 94

series of measurements is .64 by .44 mm. They are laid in the tissue of the opened flower, in the sheath of the ovary or staminal column (Plate I, Fig. 1). The female excavates a small cavity in the tissue of the staminal sheath with her snout, and, reversing her position, deposits a single egg in this cavity. Several eggs may be deposited in each flower. Table I shows the number of eggs found in cotton flowers on the College of Agriculture campus.

TABLE I.—*Showing the number of eggs deposited in mature cotton flowers.*

| Number of eggs | 0 | 1–3 | 4–6 | 7–10 | 11–15 | 16 or more | Average 5.+ |
|---|---|---|---|---|---|---|---|
| Number of flowers | 62 | 31 | 24 | 38 | 37 | 8 | Total 200 |

Table II shows the incubation period for 150 eggs deposited at different times of the year. Considerable difficulty was encountered in obtaining these data since it was necessary to observe the actual oviposition.

TABLE II.—*Showing the incubation period for eggs of Amorphoidea lata Motsch.*

| Number of days | 1 | 2 | 3 | Average 1.5 |
|---|---|---|---|---|
| Number of eggs | 73 | 71 | 6 | Total 150 |

*Larva.*—The larvae are wrinkled, grayish-white, crescent-shaped, legless grubs, with a few scattered darker hairs. The head is slightly smaller than the body, brown, pale when first hatched and darker later. Length 4 mm., breadth 1.2 mm., when mature (Plate I, Fig. 3). Immediately after hatching, the young larvae bore directly into the ovary. If the egg is delayed in hatching, the grub never gets into the ovary and consequently dies, for the sheath drops off in from three to five days after the flower opens. The larvae feed upon the tissue in the ovary and completely destroy one or more of the ovules. As many as nine larvae have been found in a single boll. In most cases the infested fruit drops to the ground before it matures, usually a few days after the flower drops. Some time previous to pupation, the larvae leave the fruit and enter the soil. When a fruit is too heavily infested with grubs, it drops to the ground while it is still so small that there is not sufficient food for the larvae. In such cases the grubs do not mature. With normal or average infestations the food is just sufficient to supply the larvae for the short feeding period. There appears, however, to be some slight ability to adapt themselves to a curtailed food supply, which may account, in some degree at least, for the variation in size found among the adults.

In addition to the feeding stage of the larval period, there is a distinct resting stage which is spent in the soil. The length of the resting stage does not appear to be quite so variable as does the feeding stage, due again, perhaps, to adaptability to variations in available food supply. Table III shows the length of time spent in the larval stage under laboratory conditions.

TABLE III.—*Showing the length of the larval stage of Amorphoidea lata Motsch.*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Feeding period. | Number of days..... | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Average 3.4 |
| | Number of larvae..... | 40 | 47 | 28 | 34 | 0 | 0 | 1*a* | Total 150 |
| Resting period. | Number of days..... | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Average 3.2 |
| | Number of larvae..... | 12 | 103 | 28 | 6 | 0 | 0 | 0 | Total 149 |
| Total larval period. | Number of days..... | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Average 6.6 |
| | Number of larvae..... | 36 | 36 | 28 | 47 | 2 | 0 | 0 | Total 149 |

*a* The grub died after feeding in the ovary for eight days.

*Pupa.*—The pupae are naked and resemble the adults generally as to form. They are grayish-white with a few scattered darker hairs. The eyes are chocolate brown and the mandibles are dark. The elytra are grayish black, much darker than the rest of the body (Plate I, Fig. 4.). Pupation takes place in the soil at a depth of from 1 to 2 cm., depending upon the texture of the soil. No definite pupal chamber is made. Table IV shows the length of the pupal stage from a series of breedings.

TABLE IV.—*Showing the length of the pupal stage of Amorphoidea lata Motsch.*

| | | | | |
|---|---|---|---|---|
| Number of days..... | 3 | 4 | 5 | Average 3.7 |
| Number of larvae..... | 46 | 96 | 7 | Total 149 |

*Adult.*—Head minutely and shallowly pitted, pale to reddish brown and sparsely pubescent; eyes lateral, convex and nearly circular. Rostrum about as long as prothorax, sides parallel. Antennae light brown arising from middle of rostrum, elbowed, clavate; joint 1 almost as long as all the succeeding, resting in a grove on the basal half of the rostrum and reaching to the eye, 9 greatly swollen and more pubescent. Prothorax 1½ times as broad as long, sides rounded, broadest in middle, narrowed slightly behind and strongly constricted anteriorly, minutely pitted, and pale, with fine sparse golden pubescence below. Scutellum present. Elytra ovate, chocolate, with golden brown scales, not covering last abdominal segment, striate, and finely pitted. Abdomen below, and legs pale with golden pubescence. Length 3.5 mm.; breath 1.2 to 1.7 mm.

The adults (Plate I, Fig. 5), rest for a day or so after emerging, often several days, then start feeding upon the flowers of the various food plants. They enter the flower when it first opens and the attack continues until it matures and falls. Copulation takes place within the flowers and the process does not seem to interrupt the feeding of the female. In the cotton fields of the College of Agriculture campus, up to thirty beetles were found in the flowers, and very few mature flowers were observed without at least one beetle. Table V shows the relative attack on unopened buds, newly opened flowers, and mature flowers.

TABLE V.—*Showing the infestation of cotton flowers by Amorphoided lata Motsch.*

| Age of flowers. | Number of flowers. | Number of beetles. | Number of beetles per flower. |
|---|---|---|---|
| Buds | 140 | 120 | 0.8 |
| Newly opened flowers | 405 | 688 | 1.7 |
| Mature flowers | 482 | 39 | 0.08 |

Considerable variation as to size and color in the adults was observed. As a rule the males are smaller, but too much overlapping in size occurs to use size as a character for distinguishing the sexes. Size variation in this beetle is not entirely sexual. Similar variation without definite relation to sex has been observed in the case of the Mexican cotton ball weevil (1). And similarly with the Mexican cotton boll weevil, dissection is the only definite means of differentiating the sexes, except when they are found in copula.

No information is at hand relative to the longevity of the adult under normal conditions. Specimens confined without food in a moist chamber with soil, lived for a period of from 4 to 12 days. In jars without moisture they died in from 1 to 3 days, a few lived beyond the third day. Unless there are other host plants than those observed, the weevil must hibernate for a considerable period of the year, since during the season from June to October neither host plant is normally in bloom.

*Summary.*—If food is available, there is a continuous series of generations throughout the year. Cotton plantings on the College of Agriculture campus have furnished a continual supply of larval food and the length of the life cycle does not materially vary in any part of the year. Table VI is a summary of the life breeding experiments carried out under laboratory conditions.

TABLE VI.—*Showing the life cycle of Amorpho dea lata Motsch.*

| | Egg stage, days. | Larval stage, days. | Pupal stage, days. | Total days. |
|---|---|---|---|---|
| Minimum | 1 | 5 | 3 | 9 |
| Maximum | 3 | 9 | 5 | 17 |
| Average | 1.5 | 6.6 | 3.7 | 11.8 |

## FOOD HABITS

*Larval.*—The eggs of the weevil are so placed that the normal food is immediately available. The larvae eat their way through the remaining part of the ovary sheath and into the ovary itself. In the ovary they feed upon the tissue of the ovary wall, the placentae, the ovules, and the immature fiber. Usually the entire contents of the ovary are eaten before the larvae leave it to pupate. Hunter and Hinds (1) described *Anthonomus grandis* larvae as feeding upon the square, especially in the younger larval stage. Observations on *Amorphoidea lata* larvae show that such is not the case with the latter species, that they are practically always found within the ovary. Larvae which hatch from the egg after the square has fallen, die.

*Adult.*—A few days after emergence, the adults commence feeding. They attack the petals, stamen, and pistil. The petals are eaten through and often badly riddled, especially near the base. The stamen and anthers are cut off or devoured, and the pistil is sometimes entirely destroyed. The attack on the flower parts often results in the early falling or rotting of the flower. Attacks on young bolls may destroy the boll completely, or may cause it to drop prematurely. Attacks on the older ovaries are usually of less importance. The punctures are visible as small spots on the surface of the fruit, caused by the healing over of the wound. No attack on leaves or stem has been noted.

## FOOD PLANTS

All species and varieties of *Gossypium* grown on the College of Agriculture campus during the last two years were attacked by both the larvae and adults of *Amorphoidea lata*. The following cotton varieties at Los Baños have been noted as hosts:

1. C. A. 16912—From Chieng, Mori, Siam.
2. C. A. 10253—From Zamboanga, Mindanao.
3. C. A. 17105—Batangas white.
4. C. A. 17630—Batangas brown.

It has been found to be serious pest of all the cultivated cotton varieties grown in the province of Ilocos Norte and Batangas. No figures are available as to the relative susceptibility of the varieties, but it is possible that any varieties, the square of which would fall very soon after opening, would exhibit a smaller degree of infestation, as the square must remain until the eggs hatch in order that the larvae may get into the ovary and develope. This point is worthy of further investigation.

The only wild host plant observed was *Thespesia lampas* (Cov.) Dalz & Gibs. (Marakapas.) Heavy infestations of fruits and flowers were noted at Los Baños, Laguna, and San José, Mindoro. This plant is widely scattered in the Philippines and appears to be a natural host for the weevil. No preference is shown between cotton and Marakapos. No larvae and but few adults have been observed on *Thespesia populnea* (L.) Corr.

Adults were found in the flowers of the native gomamela (*Hibiscus rosa-sinensis* Linn.) but the larvae would not develop on this plant. Possibly other closely related *Malvaceae* may furnish food for the adults, but none have been observed as hosts. A decided preference was noted for cotton over gomamela flowers. In cages, the adults invariably left the gomamela flowers upon the introduction of cotton flowers.

## IMPORTANCE AND POSSIBILITIES

There is considerable difficulty in estimating the damage produced by the cotton boll weevil, occuring as it does on what is minor crop in the Islands and one upon which no comprehensive production figures are available. In all of the cotton growing regions of the Philippines, the weevil is abundant. A large percentage of bolls fall to the ground and never mature. Some data are summarized in Table VII which indicate that the principal cause for the dropping is weevil injury.

TABLE VII.—*Showing the infestation of young fallen cotton bolls by the larvae of Amorphoidea lata Motsch.*

| Date 1922. | Number of bolls collected. | Number of bolls with weevils. | Number of bolls without weevils but showing injury | Number of bolls with no sign of weevil attack. |
|---|---|---|---|---|
| April 19 | 20 | 11 | 9 | 0 |
| April 20 | 12 | 8 | 4 | 0 |
| April 21 | 20 | 12 | 4 | 4 |
| April 22 | 15 | 5 | 9 | 1 |
| April 23 | 16 | 11 | 5 | 0 |
| April 24 | 17 | 12 | 5 | 0 |
| April 25, | 22 | 17 | 5 | 0 |
| Total | 122 | 76 | 41 | 5 |

Bolls attacked by weevil grubs fall to the ground and never produce mature seeds or fiber. The great abundance of the pest must necessarily result in a correspondingly large loss in cotton production. From observation it seems that this weevil is the most serious insect enemy of cotton in the Philippine Islands, despite the fact that among the other pests attacking cotton here may be listed such important insects as the pink boll worm (*Pectinophora gossypiella* Saund.), the green plant bug (*Nezara viridula* Linn.), the cotton leaf roller (*Sylepta derogata* Fabr.) and the oriental cotton stainer (*Dysdercus megalopygus* Bredd.).

Injury by adult weevils is far less important than is the larval damage. In some cases they may destroy the flowers, and in a few instances, cause the destruction of the very young bolls. The principal effect of the adult attack seems to be that of causing the flower to drop much earlier than it normally would. It appears from the knowledge that the eggs are laid in the flower parts and that the young larvae must hatch and get into the ovary before the flower drops in order to live, that, unless the early falling of the flower affects the development of the boll, the adult attack is somewhat beneficial.

While all the cotton growing regions of the Philippines are probably already infested with the boll weevil, if there are any which are not, no effort should be spared to avoid infesting them. Unfortunately the extent of distribution of the various economic species in the Islands is not known, and any internal quarantine, to be effective, must be based upon such definite knowledge. For this reason, as well as for many others, a pest survey of the Philippine Islands is one of the pressing needs of economic entomology here today.

The possibility of introducing this pest into foreign countries seems rather remote. The exceedingly short life history period eliminates the danger of introduction of the larvae by means of seed. Further, infested bolls never mature, and thus seed cotton would not contain the grubs. Some danger is present in shipping the adults along with plants, soil, seeds, or raw cotton. Practically no danger exists from ginned cotton. Care should be exercised to see that all raw cotton, seed, plants, and soil are free from the pest before shipment.

## SUMMARY

1. *Amorphoidea lata* Motsch., is found in Manila, Laguna, Batangas, Mindoro, Ilocos Norte, Romblon, Mindanao, and possibly in other provinces of the Philippine Islands.

2. The various stages of the weevil are described, and records of breeding experiments are included, showing that the average length of the life history is from eleven to twelve days.

3. The larvae feed in young cotton bolls and completely destroy them.

4. Adults feed upon the flower parts, but the injury is of minor importance.

5. The larvae are found on all varieties of cultivated cotton and on *Thespesia lampas* (Cav.) Daltz & Gibs. (Marakapas).

6. The adults feed on the flowers of other *Malvaceae* as well as on the larval food plants.

7. The weevil is the most important insect pest of cotton in the Philippine Islands.

8. There is little danger of the weevil being introduced into other countries by cotton shipments. Some slight danger exists in transporting the adults in raw cotton, packages of seed, plants, or soil.

## BIBLIOGRAPHY

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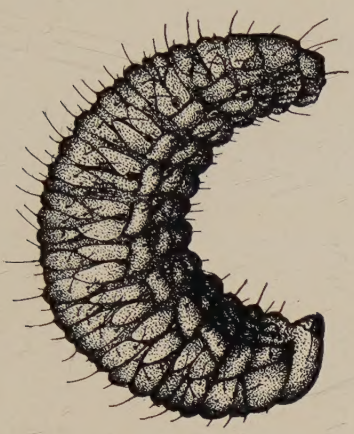
## ILLUSTRATIONS

### Plate I

Lower Left Figure. Egg *in situ*.
Lower Center Figure. Egg x 30.
Upper Right Figure. Larva x 20,
Upper Left Figure. Pupa x 15.
Lower Right Figure. Adult x 17.



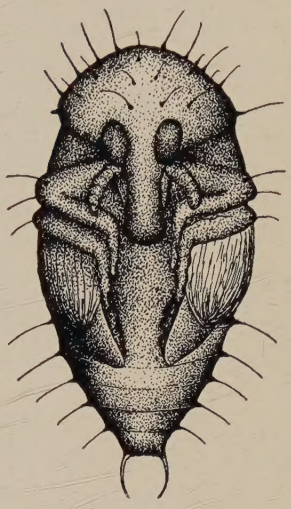


PLATE I.

# COLLAR INJURIES: THEIR CAUSE AND PREVENTION

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Excluding specific diseases and lameness, it would be difficult to point to a greater source of inefficiency and enforced idleness of horses than that of injuries inflicted upon their shoulders by poorly fitting collars. It is by no means an uncommon sight to see horses in perfect health and otherwise in the very pink of working condition rendered useless for considerable periods of time because of these injuries. Such injuries result in much discomfort and annoyance to the animals, a material decrease in their efficiency, and a distinct economic loss to the owner. At the same time there is probably no condition which is in so large a measure preventable and which may, with the exercise of judgment and discretion, be so easily and completely avoided.

It is true that a few horses by reason of the conformation of their shoulders, their physical condition, or the nature of their work are predisposed to this class of ailment. However, it may be safely ventured that the majority of cases results from a lack of knowledge as to what is required for the proper fitting of a collar, rather than from the horse himself or from the carelessness or indifference of the attendant. A thorough knowledge of the anatomical structures involved and the modifications which occur in the parts as a result of locomotion are prerequisites to a clear conception of the subject of collar fitting.

It may be accepted as axiomatic that collar injuries are the effect of a definite cause and are never of accidental occurrence. If the cause be removed the effect will disappear. Analysis leads to the conclusion that the cause must be one of two factors; either pressure or friction on the injured part. How to recognize which of these two factors is the cause, detect the means by which it is operating, and finally the manner in which it may be overcome are, therefore, very pertinent questions.

In presenting this article to the readers of *The Philippine Agriculturist* the endeavor of the writer has been to set forth the knowledge he has gathered on the subject both from reading and experience with the hope that it may prove of service to those having horses under their care.

## TYPES OF COLLARS

There are two types of collars in common use; the breast or Dutch collar and the full or neck collar. The former is the simpler type but is only suitable for the lightest draft. It is rarely the cause of any damage to the shoulders. The full collar is the great offender and this paper is restricted to a consideration of that type.

## CONDITIONS OF COLLAR FITTING

The horse's requirements in regard to collar fitting may be more readily understood if a few observations are borne in mind concerning the shape and structure of the shoulders and the movements which they undergo.

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[1] Experiment Station No. 95

Upon viewing the horse at rest a distinct depression is seen at the line of junction of the neck with the shoulders. The collar rests in this depression and because of this fact it is commonly known as the collar bed or collar rest. The deeper and more hollowed-out the depression, the more flatly and evenly the collar will lie against the anterior borders of the shoulder blades. A collar resting on such a bed insures an even and uniform distribution of weight over the shoulders when resistance is thrown against them in the performance of draft and it represents the type of shoulder best adapted for this work.

The shoulders and necks of horses, however, vary in their size and shape almost as much as the heads of people and no two are exactly alike in this respect. In some necks the crests are found very thick and wide from side to side while in others the opposite is the case. In some horses the necks are very thin in the middle, while in others the musculature is large and well developed. Similar examples might be given at length but the two cited are sufficient to show the necessity of each horse having its own individual collar made to measure if its shoulders are to be kept in a sound condition. If possible a horse should always be fitted with a collar when he is in working condition. It is often surprising to observe how collar requirements vary in cases where fat is gained in idleness or good feeding and where it is lost by work. When horses are worked very early in life before they have attained their full growth, as is often the case in the Philippines, the shoulders increase in width and depth so that frequent changes to larger collars are necessary.

Before entering into the details of collar fitting attention must be given to the movements of the shoulders in locomotion and the bearing which they have upon the subject. On inspecting the animal's shoulders while at rest, the collar bed is found to consist of two perfectly parallel shoulder surfaces against which the collar is flatly apposed. When the horse is in motion this aspect is entirely changed as the shoulder blades are constantly and alternately moving backward and forward. While one shoulder is coming forward the other is going backward so that the collar is at no time actually resting on flat parallel surfaces such as are presented by the two shoulders at rest. The shoulder surfaces are always oblique. As a result of this movement considerable oscillation of the collar is produced. A collar also rises on the shoulders when a horse puts its weight against it, although this occurs to a less extent with upright shoulders than with more oblique ones.

The oscillation of the collar as a result of shoulder movements is the most important cause of collar injuries. The oscillation results in friction between the collar and the parts beneath and as a sequel abrasions of the skin occur which increase in extent and severity unless the cause is promptly removed. The collar should fit so closely that but little oscillation or lateral movement is possible but not to the extreme, however, of pinching the sides of the neck.

## THE FITTING OF THE COLLAR

In examining the fit of a collar the following are the essential points to which attention must be directed:

(1) The collar should lie flatly against the shoulders and settle into its position easily. If any effort is required to force it into place the width is insufficient and injury to the sides of the neck will certainly follow its use.

(2) It should be observed that the collar has a level and even bearing over all parts of the collar bed from top to bottom. To ascertain this the top of the collar may be grasped with one hand and the bottom or throat with the other. The collar may then be pressed back firmly against the shoulders and no rocking or see-saw motion should be possible. If such is possible it indicates that the center of the body of the collar contains too much stuffing.

(3) Between the collar and the neck just in front of the withers there should be a space sufficient to permit the insertion of the flat of the hand.

(4) Between the inside of the collar and the sides of the neck the fit should be so close that the space which exists will admit the flat of the fingers and no more. This space should be found from the top to the bottom of the neck. Care should be observed that the fit is not so close as to pinch the sides of the neck. Quite frequently the proper space is found at the upper part of the neck but between its lower third and the collar the space is too great. This results in too much play, which of course means friction with its attendant evils.

(5) The amount of lateral motion in the collar is ascertained in the following manner: Taking hold of the collar at the top and bottom with both hands as in (2) it is pressed firmly back against the shoulders and worked from side to side. About the shoulder joint the movement should not be as much as two inches. This amount or anything in excess of it is an indication that the collar is too wide and damage to the shoulders is certain to follow its use.

(6) The depth of the collar is important and must be examined. In draft, especially up-hill, the collar rises on the shoulders, hence the necessity of having the throat of the collar well away from the neck when the animal is at rest. If the collar be too short when weight is thrown against it, undue pressure is caused on the trachea thereby impeding the breathing. To test the depth of the collar insert the flat of the hand between the throat of the collar and the horse's neck. If the collar is deep enough the hand and wrist should find ready admission; anything more is unnecessary and even undesirable. Too deep a collar is objectionable because it gives rise to additional friction.

(7) The bearing surface of a collar should be hard and smooth. The body can hardly contain too much stuffing providing it is well placed as this insures the pull of the load being evenly distributed over a large surface. Moreover, continuous wear compresses the stuffing so that the body becomes flatter. Not infrequently in old collars this allows the edge of the afterwale to extend beyond the body of the collar and come in contact with the skin of the shoulder. This point must not be overlooked if the examination is to be thorough.

(8) The hames should fit accurately into their groove and conform strictly to the shape of the collar in their curvature. If the hames are too straight a collar which fits well without them will be found too tight when they are applied. The hames considerably increase the rigidity of the collar and help to close those which are open at the top. They are not in themselves sufficient to effect this, however, and a housing strap must accompany this type of collar. The strap should be drawn as tightly as possible, as should also the hames strap in order to prevent the hames from sliding about or coming out of their groove.

(9) With a properly fitted collar the attachment of the traces to the hames should be such that a pull as nearly as possible at right angles to the line of resistance is effected. Then the collar will bear directly against the shoulder and not

be borne down upon the withers nor up against the trachea. Furthermore, the height at which the attachment of the hames is made should be such as to distribute the bearing proportionately over the collar bed and to allow the greatest freedom of shoulder motion. If the traces are attached too high the greatest weight is borne upon that part of the collar bed which is least capable of sustaining it. If attached too low, as is most commonly the case, the movements of the shoulders are hampered and a backward and forward motion is given to the collar. The trace attachments to the hames must be of equal height. It is not uncommon to observe one trace attached higher or lower than the one on the opposite side.

## COLLAR INJURIES AND THEIR PREVENTION

There is no part of the neck and shoulders entering into the formation of the collar bed which may not suffer damage as the result of a defective collar. The severity of the injuries produced ranges from mere skin abrasions in the mildest form to actual involution of the bone in the most aggravated cases. Occasionally, abscess formation occurs about the region of the shoulder joint around which, as a center, grow large, hard, tumified masses of connective tissue resulting often in permanent deformity of the shoulders. The location of the injury is of significance in indicating what part of the collar is at fault. An intelligent inspection of the fit of the collar about this region should readily reveal the trouble and the means of rectifying it. A brief description of the more common collar injuries, their location, nature, cause and prevention follows:

(1) The injury which occurs at the top of the neck just in front of the withers is a particularly painful one, so much so that one may encounter great difficulty in approaching the animal to make an examination. In some cases the sensitiveness is so great that the animal shows alarm when one merely points at the part even though the affected surface is no larger than the thumb nail. Injuries at this location furnish the one example of collar injury due to pressure. All others are invariably the result of friction. This injury resembles those sustained by the back in this regard and also in the similarity of the lesion produced. A circumscribed area of skin frequently undergoes necrosis in much the same manner as in the formation of a sitfast.

The usual cause of this injury is a collar not completely closed at the top thus allowing it to slide down on the shoulders so that its entire weight is suspended on the top of the neck. For this reason the housing strap closing the top of the collar should be drawn as tightly as possible. A space as described in (3) above should exist between the neck and the collar for equally obvious reasons. Some collars are made with the desirable feature of being chambered, that is containing less stuffing at this location so that there is a distinct depression. The so-called Kay collars, those made in one piece and completely closed at the top, are far less likely to produce the injury. Key collars, however, are essentially of light weight as they cannot be made heavy and durable enough for heavy draft work without being cumbersome to handle. Their use is advocated whenever feasible. The injury is more common with horses working in double harness than with those working singly. In double hitches the weight of the wagon tongue through the chains exerts a pulling down effect on the collar in going down grade and in stopping the vehicle. Shortening the pole-chains to the extent of lifting the tongue is also a contributing factor in the production of sore necks.

(2) Injuries to the sides of the neck just below the one described occur most frequently in thick necked horses. Upon examination the collar will be found too tight or the hames too straight. In either case the effect is the same, the part is pinched. If the collar is at fault, some of the stuffing should be removed. If this is not sufficient to overcome the difficulty the collar may be widened by stretching. It must be remembered, however, before recourse is had to this procedure, that widening a collar inevitably shortens it. Thus, while we may relieve the neck from continued injury by this method, we may at the same time so alter the shape of the collar as to produce equally serious consequences at another part of the collar bed. Unless the amount of stretching required is limited the collar had better be discarded and a properly fitted one procured. Finally, alterations to the collar are of no avail if the hames do not have the proper curvature.

(3) The part of the collar bed above the shoulder joint and under the point where the hames are attached to the collar is another common site of injury. When injuries occur in this location the collar will nearly always be found to be too wide so that there is considerable oscillation from side to side. The remedy for this condition is to increase the bulk of the collar body at this point by additional stuffing until lateral movement is practically eliminated. The injury not infrequently appears to be so far behind the collar when the animal is at rest as to lead one to question whether its occurrence may not be due to another cause. In such cases the collar is generally very much too wide and the amount of lateral movement present may be as much as four or five inches. If the test described in (5) above under "Fitting of the Collar" be applied, the collar will be found to touch the injury when worked over in its direction.

(5) A collar which is either too tight or too loose at the lower third of the neck may produce injury to the skin over quite a considerable area. The damage occurs anterior to the shoulder joint and often extends above and below so that the affected surface may be as much as five inches in length. The cause is invariably friction and an inspection of the collar will indicate which of the two mentioned faults is present in a particular case. If the collar be found too wide, a felt pad worn under the body may be sufficient to correct the condition; if not, restuffing or narrowing and shortening the collar is the only alternative.

(5) The injuries produced by collars not containing enough stuffing or those in which the body has become badly flattened through compression in draft are found behind and usually slightly above the shoulder joint. Such collars are generally quite old and the flattening of the body allows the raw edge of the afterwale to project beyond it and cut into the skin. This condition may be readily detected if the examination is conducted at a time when the animal is engaged in draft. At other times it is not so apparent and may be overlooked. The corrective is re-stuffing of the collar but generally its age is such as not to warrant the expense. Cutting off the edge of the afterwale may be resorted to as an expedient in an emergency.

## ALTERATIONS TO COLLARS

According to the nature of the changes desired, alterations to the collar may be regarded as temporary and permanent. The first class includes such methods as chambering the body and placing small pads beneath the collar to protect a sore place. Pads are seldom satisfactory, as they are often productive of more

harm than good. Instead of the whole weight in draft being distributed evenly over the collar bed it falls entirely upon the pads and the damage occasioned is generally worse than the injury they are intended to relieve. The only type of pad which should be used under a collar is one which entirely covers the under surface of its body and it must be securely attached to the collar by means of straps with buckles or clamps to prevent it from sliding out from under the collar and causing uneven pressure on the shoulders. Any temporary method of tightening the collar other than by the use of a full pad is to be severely condemned.

The shortening, lengthening and re-stuffing of collars are permanent alterations and should only be attempted by an expert. Alterations to a collar should never be made without the saddler seeing it on the horse and examining it in position. Neither should the alteration be completed until assurance is obtained that the fit is correct by trying it on the animal in a semi-finished state.

New collars are firm and stiff and they require a certain amount of wear before becoming properly adjusted to the shape of the collar bed. The difficulty may be largely overcome by immersing it in water for a couple of hours and then placing it on the horse. The collar may then be adjusted snugly to the shoulders and neck with the hames strap. The horse should be worked moderately and steadily throughout the day. Soaking the collar in this way serves to soften it and it will more readily adjust itself to every inequality of the shoulders and neck. Poorly fitting old collars may often be treated to advantage in the same manner.

In conclusion it may be emphasized that most collar injuries result from friction and their cure and prevention depends upon eliminating oscillatory movement of the collar.

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# CONCERNING THE SUGAR CANE ROOT PARASITE, AEGINETIA INDICA.[1]

By Frank P. McWhorter
*Of the Department of Plant Pathology*

WITH ONE PLATE

In those regions of the Islands where sugar cane is grown, the root parasite, *Aeginetia indica* L., is yearly becoming a more serious pest. It has been reported, described, and figured several times. The purpose of this paper is to call attention to the work of Kusano[2] who, in 1908, published an excellent paper describing the plant's life history. Kusano's careful study of the plant has yielded data that may be of use in controlling the pest here in the Islands where it seriously damages sugar cane. It damages the cane, its host, by greatly reducing the sugar content and causing the formation of substances that render the cane unfit for milling.

*Aeginetia indica* is an Indo-Malayan member of the broom-rape family. It closely resembles its western cousin, *Orobanche*, which does serious damage in Europe. Unfortunately *Aeginetia indica* is not restricted to any particular host. Kusano showed that it may be grown successfully on a large number of monocot hosts. In the field, it is found on a number of wild grasses and on many cultivated plants such as upland rice, (*Oryza sativa* L.), maize (*Zea Mays* L.), and sugar cane (*Saccharum officinarum* L.). In the Philippines it seems to be more abundant on sugar cane than on any of its other hosts. It has never been reported on any dicot. It is interesting to note that the European *Orobanche* (*Orobanche europaea*) has never been reported on any monocot.

A single plant consists of several white or pink branches arising from a common point of attachment on the host root. It has neither roots nor chlorophyll of its own; hence it must get all of its food from its host. Each branch produces several flowers and each flower produces thousands of extremely small seeds. Two hundred thousand seeds for a medium sized plant is a conservative estimate. The flowers have often been mistaken for flowers of the cane itself; they are no more part of the cane than a flea is part of a dog. Fortunately the plants are seldom more than fifty centimeters in height. Their low-growing habit and the fact that they fruit when the cane is large and beginning to mature, hinder the distribution of the tiny seeds by wind and rain. They are often, thereby, forced to distribute their seeds over a relatively small region, which may account for the great abundance of the plant in restricted areas in large fields.

## LIFE HISTORY

According to Kusano, the tiny seeds lie in the soil for months waiting for the rootlets of some holophytic plant to come near enough to furnish the stimulus necessary for their germination.[3] They cannot germinate until actual contact with a suitable host is attained. The roots of the wrong host will

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[1] Experiment Station Contribution No. 96.

[2] Kusano, S. Further studies on *Aeginetia indica*. Bulletin of the College of Agriculture, Tokyo Imperial University. 8: 59-79. 1908.

[3] Dr. N. B. Mendiola and the writer performed some experiments here at the College of Agriculture, that indicate that the seeds must after-ripen for a period of a few weeks before they will germinate.

make the seeds start germinating but they cannot complete germination until the roots of a suitable host find them. The seedlings are so small that they are invisible to the naked eye during the first stages of germination. After a few days, a small tubercle one to two millimeters in diameter is formed on the host root. The tubercle grows slowly for a while; it is then developing a very efficient haustorium that enables the parasite to form direct connections with the food and water streams of the host. When the haustorial connection has become thoroughly established, the tubercle develops rapidly and sends up a number of branches. The branches have flowers formed on them before they emerge from the ground. The entire plant mass is produced from the food of its host.

Kusano showed that the seeds of *Aeginetia* are viable for less than two years, even when the seeds are kept in a dry condition. Their viability must be considerably less in the sugar cane fields where they are exposed to moist conditions. They contain a very high fat content, which, together with their thick walled seed-coats, may serve to prevent their absorbing water until a proper host furnishes the growth stimulus. Kusano also showed, as before stated, that the host apparently must be a monocot, and that the seeds will not germinate without the stimulus of a host root.

## CONTROL MEASURES

On a basis of Kusano's excellent laboratory studies, and the author's field observations in Laguna, the following control measures are recommended:

1. That as many as possible of the attacked cane plants, together with the attached parasites, be dug up and burned, thereby preventing seed formation and distribution. Since the parasite first occurs very locally in the field, this procedure may often be very completely carried out.
2. That badly infected fields (generally ratt on stands) be ploughed deeply and then planted to some dicot crop such as mungo (*Phaseolus radiatus* L.), jack bean (*Canavalia gladiata* [Jacq.] DC.), camote (*Ipomoea batatas* [L.] Poir.), yams (*Dioscorea* spp.), or cassava (*Manihot utilissima* Pohl.). In case a very large area is infested, it would be practical to follow the cane with some leguminous cover crop, which, when turned under, will serve as a fertilizer. Wait at least eighteen months before replanting to cane. Do not follow the cane with corn or rice.
3. That it will not be feasible to attempt to develop an *Aeginetia* resistant cane; the parasite is not even confined to the genus *Saccharum*, so it will not be likely to respond to varietal host differences.

## ILLUSTRATION

PLATE I

Aeginetia on Sugar Cane

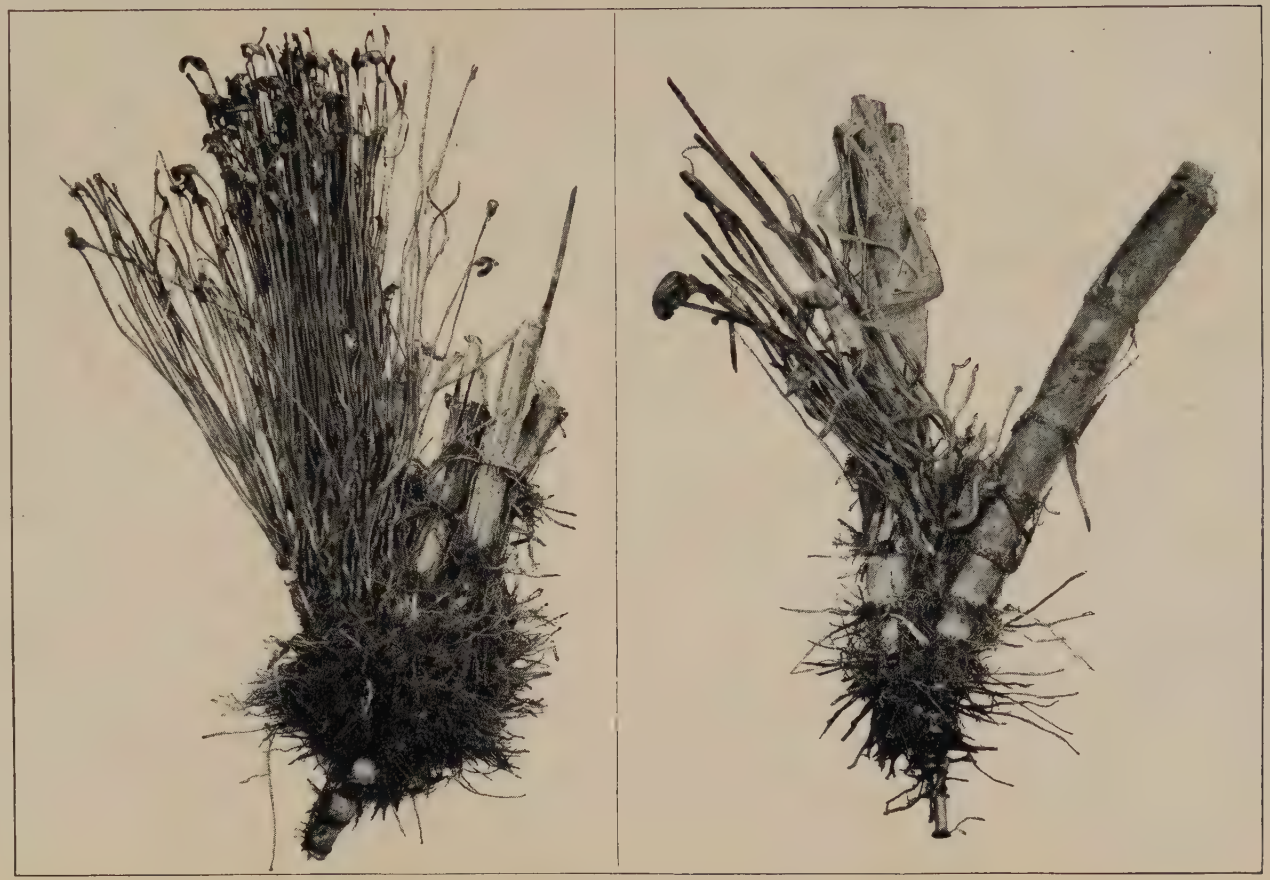

PLATE I: AEGINETIA ON SUGAR CANE

## DISTRIBUTION OF VITAMINS IN INVESTIGATED FOOD MATERIALS

The table herewith presented is in supplement to ROXAS, MANUEL L. The modern conception of nutrition and some of our food problems, *Philippine Agriculturist X: 447-465.* It is taken from SHERMAN, H. B. and SMITH S. L. The vitamines. 273 pp., New York, 1922.

\+ indicates that the food contains the vitamin.
\+ + indicates that the food is a good source of the vitamin.
\+ + + indicates that the food is an excellent source of the vitamin.
— indicates that the food contains no appreciable amount of the vitamin.
? indicates doubt as to presence or relative amount.
@ indicates that evidence is lacking or appears insufficient.

| *Source* | *Vitamin A.* | *Vitamin B.* | *Vitamin C.* |
|---|---|---|---|
| GRAIN PRODUCTS | | | |
| Barley, whole | + | + + | — |
| Bread, white (water) | ? | + | — |
| Bread, white (milk) | + | + | ? |
| Bread, whole wheat (water) | + | + + | ? |
| Bread, whole wheat (milk) | + + | + + | ? |
| Corn (maize), white | — | + + | — |
| Corn (maize), yellow | + | + + | — |
| Cottonseed meal | + | + + | @ |
| Flour, white | — | + | — |
| Grains, sprouted | + | + + ? | + + |
| Malt, green | + | + + ? | + + |
| Millet | + + | + + | @ |
| Oats | + | + + | — |
| Rice, polished | — | — | — |
| Rice, whole grain | + | + + | — |
| Rye, whole | + | + + | — |
| Wheat embryo | + + | + + ? | — |
| endosperm | — | + | — |
| middlings, commercial | @ | + + + | — |
| bran | + | + + ? | — |
| whole | + | + + | — |
| SUGAR AND STARCHES | | | |
| Glucose | — | — | — |
| Honey | — | + | — |
| Starch | — | — | — |
| Sugar | — | — | — |
| FATS AND OILS | | | |
| Beef fat | + | — | — |
| Butter | + + + | — | — |
| Coconut oil | — | — | — |
| Codliver oil | + + + | — ? | — |
| Corn oil, | + ? | — | — |
| Cottonseed oil | + ? | — | — |
| Cottonseed oil | + ? | — | — |

| *Source* | *Vitamin A.* | *Vitamin B.* | *Vitamin C.* |
|---|---|---|---|
| FATS AND OILS | | | |
| Horse fat | + | — | — |
| Lard | + ? | — | — |
| Linseed oil | — | — | — |
| Margarine, nut | — | — | — |
| Mutton fat | + | — | — |
| Olive oil | — | — | — |
| Oleo oil | + | — | — |
| Orange peel oil | + + | @ | @ |
| Palm oil, | + | — | — |
| Peanut oil | — | — | — |
| Pig kidney fat | + + | — | — |
| Whale oil, | + + | @ | — |
| MEATS AND FISH | | | |
| Brains | + | + + | + ? |
| Fish, lean | — | + | @ |
| fat | + | + | @ |
| Heart | + | + | + ? |
| Kidney | + + | + + | + ? |
| Liver | + + | + + | + |
| Meat (muscle) | — to + | + ? | + ? |
| Meat extract | — | — ? | — |
| Meat, canned | — | slight | — |
| Roe, fish | + | + + | + ? |
| Sweetbreads | + | + | @ |
| FRUITS | | | |
| Apples | + | + | + |
| Bananas, | + ? | + ? | + |
| Cloudberries | @ | @ | + + + |
| Cloudberries (canned) | @ | @ | + + + |
| Cocum (dried) | @ | @ | + |
| Grape juice, | @ | + | + |
| Grapefruit | @ | + + | + + |
| Lemon juice | @ | + + | + + + |
| juice dried | @ | + + | + + + |
| Limes | @ | + | + |
| Mango | @ | @ | + |
| Mulberries, | @ | @ | + |
| Orange juice | + | + + | + + + |
| peel | + | + | + + |
| Pears | @ | + | @ |
| Prunes | @ | + | — |
| Raspberries | @ | @ | + + + |
| Raspberries (canned) | @ | @ | + + + |
| Tamarind, dried | @ | @ | + |
| Tomatoes, raw | + + | + + + | + + + |
| canned | + + | + + + | + + + |
| dried | + + | + + + | + + |
| VEGETABLES | | | |
| Alfalfa | + + + | + + + | @ |
| Beans, kidney, | @ | + + + | @ |
| navy | @ | + + + | — |
| soy | + | + + + | — |
| sprouted | @ | @ | + + |
| string, fresh | + + | + + | + + |

| *Source* | *Vitamin A.* | *Vitamin B.* | *Vitamin C.* |
|---|---|---|---|
| **VEGETABLES** | | | |
| Beets | @ | + | @ |
| Cabbage, fresh raw | + | + + + | + + + |
| cooked | + | + + | + + |
| dried | + | + + | + |
| green | + + | + + | + + + |
| Carrots, fresh raw | + + | + + | + + |
| cooked | + + | + | + |
| Cauliflower | + | + + | + |
| Celery | @ | + | @ |
| Cress | @ | @ | + |
| Chard | + + | + | @ |
| Cucumber | @ | + | @ |
| Dandelion greens | + + | + + | + |
| Dasheens | — ? | + | + |
| Eggplant (dried) | @ | + + | @ |
| Endive | + | @ | + |
| Legumes, sprouted | @ | @ | + + |
| Lettuce | + + | + + | + + + |
| Onions | @ | + + | + + |
| Parsnips | — ? | + + | @ |
| Peas | + + | + + | + ? |
| Peas, sprouted | @ | @ | + + |
| Potatoes, sweet | + + | + | @ |
| white raw | + | + + | + + |
| white boiled (15 minutes) | @ | + + | + + |
| white boiled (1 hour) | @ | + + | + |
| white, baked | @ | + + | + |
| Radish | @ | + | @ |
| Rhubarb | @ | @ | + |
| Rutabaga | — ? | + + | + + + ? |
| Sauerkraut | @ | @ | — ? |
| Spinach, fresh | + + + | + + + | @ |
| dried | + + + | + + | @ |
| Squash, Hubbard | + + | @ | @ |
| Swede | @ | + + | + + + ? |
| Turnips | — ? | + + | @ |
| **NUTS** | | | |
| Almonds | + | + | @ |
| Brazil nuts | — ? | + + | @ |
| Chestnuts | @ | + | @ |
| Coconut | + | + | @ |
| Coconut press cake | + | + | @ |
| Filberts | @ | + + | @ |
| Hickory nuts | @ | + + | @ |
| Peanuts | + | + + | @ |
| Pecans | @ | + | @ |
| Pine nuts | + | + | @ |
| Walnuts, black | @ | + + | @ |
| Walnuts, English | @ | + + | @ |
| **MILK** | | | |
| Milk | + + + | + + | + variable |
| condensed | + + + | + + | + variable |
| evaporated | + + + | + + | — ? |
| dried, whole | + + + | + + | + variable |
| dried, skim | + | + + | + variable |
| Skimmed milk | + | + + | + variable |

| *Source* | *Vitamin A.* | *Vitamin B.* | *Vitamin C.* |
|---|---|---|---|
| DAIRY PRODUCTS | | | |
| Butter | + + + | — | — |
| Buttermilk | + | + + | + variable |
| Cream | + + + | + + | + variable |
| Cheese | + + | @ | @ |
| Cottage cheese | + | @ | @ |
| EGGS | | | |
| Eggs | + + | + | + ? |
| Eggs, white | @ | @ | @ |
| Eggs, yolk | + + + | + | @ |
| YEAST | | | |
| Yeast | — | + + + | — |
| Yeast extract | — | + + + | — |

ABSTRACT

**La dyspepsie parasitaire et le complexus symptomatique lié au parasitisme gastro-intestinal.**[1] **Diagnostic et traitement.** M. le Dr. Roger, (*Journal de Médecine Vétérinaire et de Zootechnie* **68**: *73-85; 153-165.*)—The author discusses gastro-intestinal parasitism of equines from the clinician's viewpoint and states that our knowledge of the clinical phase of that morbid condition is far behind our knowledge of its zoological phase. The term parasitic dyspepsia is employed to designate the symptom complex produced by parasites living in digestive tract of equines, including such forms as bots (larvae of species of *Gastrophilus*), ascarids (*Ascaris equorum*), palisade worms (species of *Sclerostomum*), species of *Cylicostomum, Oxyuris,* and other nematodes of common occurrence in the digestive tract of horses.

These parasites produce a variety of symptoms the most striking disturbances, involving the digestive, circulatory, respiratory and nervous systems.

The animal's appetite may be increased or diminished and is frequently perverted. Nausea, yawning, flatulency, constipation, diarrhea, entero-colitis, colic, straining of the bowels, mucoid stools, prolapse of rectum, and anal pruritis are the most marked disturbances of the digestive system. The author also states that the condition known as "lampas," namely a swelling of the mucous membrane that covers the hard palate and projects in a ridge immediately behind the upper incisors, is a manifestation of intestinal parasitism in horses.

Disturbances in the circulatory system include a diminution in the number of red blood corpuscles (oligocythemia), a diminution in the volume of the red clot as compared to the volume of the serum and pale mucous membranes. The author states further that horses that are anemic despite the fact that they are well fed in proportion to the work that they do should be considered infested with gastro-intestinal parasites in the absence of other anemia producing factors, such as aortitis, leukemia, Bright's disease, rheumatism or convalescence from an infectious disease. Young horses that are anemic are in nine cases out of ten infested with parasites. In older horses, however, anemia may be due to organic troubles, such as diseases of the digestive and respiratory systems, of the kidneys, auto-intoxication, oxalemia, etc. The leucocyte count presents considerable variation involving an increase in the polymorphynuclears and eosinophiles and a diminution in the lymphocytes and mononuclears. Following treatment the polymorphynuclears diminish and the mononuclears increase, a phenomenon that has considerable prognostic value. Oedema of the eyelids and of the limbs, and a functional venous pulse are also frequent.

The respiratory disturbances are breathlessness and a cough. The latter is sometimes of gastric origin but is more often pulmonary (pulmonary habronemiasis).

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1 Gastro-intestinal parasitism is of very common occurrence in horses in the Philippine Islands. So far as is known, bot-fly larvae have not been encountered in native horses and it is very probable that these parasites do not occur in the Philippines. The other species of parasites mentioned in this paper are very abundant, however, and are undoubtedly responsible for many pathological conditions in equines.

Nervous troubles, such as vertigo, epilepsy, vascular spasms and psychic disturbances, which appear suddenly, and which subside following the expulsion of the parasites are common.

In addition to the symptoms already described, there are general disturbances, such as lowering of vitality, flaccid muscles, emaciation, fever while the animal is working, renal and hepatic insufficiency, sterility, and even abortion.

The presence of intestinal worms may be diagnosed with the aid of the microscope but the presence of Gastrophilus larvae can be detected only by the presence of gastric symptoms. Carbon bisulphide and oil of turpentine gave very satisfactory results as medicinal agents. Carbon bisulphide was found effective against parasites in the upper part of the digestive tract, namely, bots, ascarids and habronemas (stomach worms). The drug was administered in castor oil, morning and evening, the dose being 12½ grams of carbon bisulphide in 100 gms. of castor oil, making a total dose of 25 grams or 20 cc. of carbon bisulphide. This dose was sufficient for horses weighing 350 to 400 kilograms. The larvae of Gastrophilus begin to leave the host within 24 to 48 hours following this treatment and continue their exodus for a few days. Within 8 days after treatment practically all larvae have been expelled. Carbon bisulphide was found to be potent against all species of Gastrophilus and equally potent against ascarids.

Against intestinal parasites oil of turpentine was found to be an excellent remedy, the dose being 50 to 60 grams of turpentine in 500 grams of castor oil. It is seldom necessary to administer a second dose of this drug, as the first dose usually expels nearly all intestinal parasites.

In order to enable animals to recover from the effects of parasitism, arsenic, arsenious acid, sodium cacodylate and other drugs are recommended following anthelminthic medication.

The author states that just as in the practice of human medicine chronic ailments of unknown etiology always arouse a suspicion of syphilis, tuberculosis or rheumatism so in veterinary medicine, similar conditions warrant a suspicion of parasitism.

He recommends that horses be treated twice a year, namely after the rainy season, and early in autumn.

*Abstracted by B. Schwartz*

## COLLEGE AND ALUMNI NOTES

### RESOLUTIONS OF THE STUDENT BODY

*Whereas*, on July 17, 1921, the Student Body of the College of Agriculture was deprived of the companionship of Mr. Vitaliano Rodriguez Ylanan by his untimely death, and

*Whereas*, in his passing we have lost an ardent co-student and his valuable help as a member of the Student Body, and

*Whereas*, in him we have lost a promising student in the prime of his young manhood, be it therefore

*Resolved*, that we, members of the Student Body, extend our sincere sympathy and condolence to the bereaved parents and relatives, joining in their grief, and be it further

*Resolved*, that this resolution be spread in the minutes of the Student Body, and be it further

*Resolved*, that a copy of these resolutions be sent to the bereaved family of the deceased; and that copies thereof be sent to the Philippine Agriculturist and the Philippine Collegian for publication.

Dated at the College of Agriculture, University of the Philippines, Los Baños, this Seventh Day of August, in the Year of our Lord, Nineteen Hundred and Twenty-two.

BY THE COMMITTEE:
*Alexander Gordon*
*Gregorio Antenor-Cruz*
*Gonzalo H. Salazar*

### RESOLUTIONS OF THE COLLEGE OF AGRICULTURE ALUMNI ASSOCIATION

*Whereas*, on August 19, 1922, the death of Rufino Custodio Cuitiong, B. Agr. '22, of Tanay, Rizal, deprived us of the companionship of a co-alumnus;

*Whereas*, this untimely demise of Rufino Custodio Cuitiong means a loss of leadership for the fostering of agricultural science and education in the Philippines;

*Whereas*, the friendly character, pleasing personality, and helpful disposition of said Rufino Custodio Cuitiong have always commanded the sympathy, admiration and friendship of those who have associated with him, now therefore be it

*Resolved*, that we, the members of the College of Agriculture Alumni Association, express, as we do hereby express, our deep sorrow for this lamentable death of a *friend* and a *leader* in our chosen field of Agriculture; be it further

*Resolved*, that we extend our heartfelt sympathy to the bereaved parents and relatives of the deceased; and be it further

*Resolved*, that a copy of these resolutions be spread upon the minutes of the Association, and that a copy thereof be sent to the parents of the late Rufino Custodio Cuitiong, and that the *Philippine Agriculturist* and the *Philippine Farmer* be requested to publish the same.

Dated at the College of Agriculture, University of the Philippines, Los Baños, Laguna, this Nineteenth Day of September, in the year of One Lord Nineteen Hundred and Twenty-two.

THE COMMITTEE ON RESOLUTIONS:
*Rafael Piguing*
*Rafael B. Espino*
*Elias M. Caray*